

## Pop Quiz:

- (a) Find the derivative of the following function from first principles:

$$g(x) = -12(x-3)^2 + 6$$

- (b) Explain what the derivative represents.

$$\begin{aligned} g(x) &= -12(x^2 - 6x + 9) + 6 \\ &= -12x^2 + 72x - 102 \end{aligned}$$

$$\begin{aligned} g'(x) &= \lim_{h \rightarrow 0} \frac{g(x+h) - g(x)}{h} \\ &= \lim_{h \rightarrow 0} \frac{-12(x+h)^2 + 72(x+h) - 102 - (-12x^2 + 72x - 102)}{h} \\ &= \lim_{h \rightarrow 0} \frac{-12x^2 - 24xh + 12h^2 + 72x + 72h - 102 + 12x^2 - 72x + 102}{h} \\ &= \lim_{h \rightarrow 0} \frac{12h^2 - 24xh + 72h}{h} \\ &= \lim_{h \rightarrow 0} 12h - 24x + 72 \quad h=0 \end{aligned}$$

$$g'(x) = 72 - 24x$$

L4 (1.4) Limits - Part 1 p.37 at top.

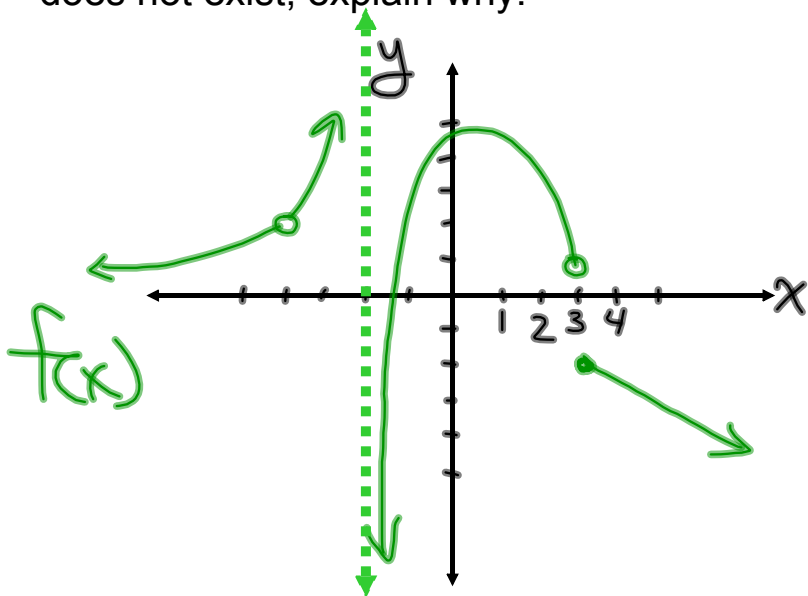
The limit of a function exists if the following 3 conditions are met:

- 1)  $\lim_{x \rightarrow a^-} f(x) = L$       The limit approaches a value  $L$  from the left of "a".
- 2)  $\lim_{x \rightarrow a^+} f(x) = L$       The limit approaches a value of  $L$  from the right of "a".
- 3)  $\lim_{x \rightarrow a^-} f(x) = L = \lim_{x \rightarrow a^+} f(x)$       The limit approaches the same value from both sides.

**NOTE:** If a limit yields an answer of  $\pm\infty$  we say the limit DNE.

Does  
Not  
Exist

Ex1: Use the graph to evaluate each limit if it exists. If the limit does not exist, explain why.



a)  $\lim_{x \rightarrow -4^-} f(x) = 2$  ✓

b)  $\lim_{x \rightarrow -4^+} f(x) = 2$  ✓

c)  $\lim_{x \rightarrow -4} f(x) = 2$

d)  $\lim_{x \rightarrow -2^-} f(x) = +\infty$

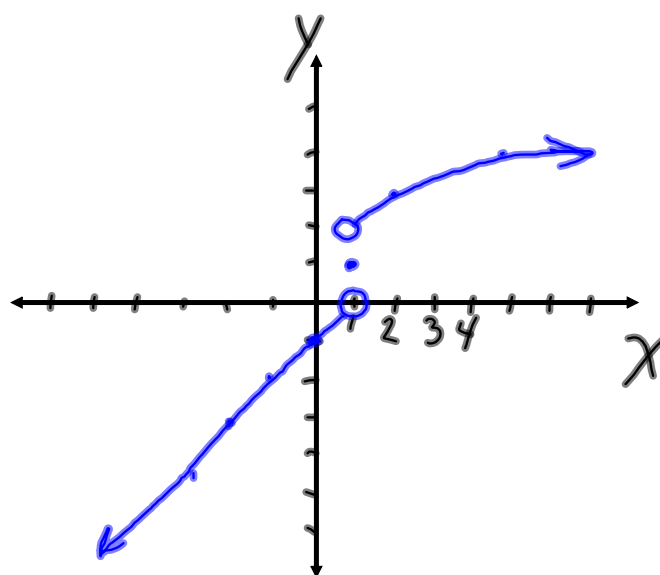
e)  $\lim_{x \rightarrow -2} f(x) = \text{DNE}$

f)  $\lim_{x \rightarrow 3} f(x) = \text{DNE}$

$$\left\{ \begin{array}{l} \lim_{x \rightarrow 3^-} f(x) = 1 \\ \lim_{x \rightarrow 3^+} f(x) = -2 \end{array} \right.$$

Ex2: Sketch the graph of the piecewise function then find  $\lim_{x \rightarrow 1} f(x)$ .

$$f(x) = \begin{cases} x-1, & x < 1 \quad \checkmark \\ 1, & x = 1 \quad \checkmark \\ 2 + \sqrt{x-1}, & x > 1 \end{cases}$$



$$\lim_{x \rightarrow 1^-} f(x) = 0$$

$$\lim_{x \rightarrow 1^+} f(x) = 2$$

$$\lim_{x \rightarrow 1} f(x) = \text{DNE}$$

Ex3: Evaluate each limit if it exists. If it does not exist, explain why.

$$\text{a) } \lim_{x \rightarrow -3} x^3 - 2x^2 + x + 1$$

$$= (-3)^3 - 2(-3)^2 + (-3) + 1$$

$$= -27 - 18 - 3 + 1$$

$$= -47$$

$$\text{b) } \lim_{x \rightarrow 5} \frac{1}{x-5}$$

$$\lim_{x \rightarrow 5} \frac{1}{x-5} = \text{DNE}$$

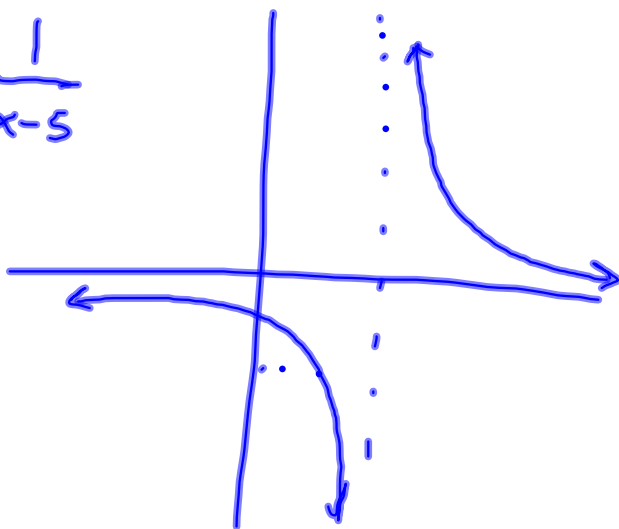
$$\lim_{x \rightarrow 5^-} f(x) = -\infty$$

$$\lim_{x \rightarrow 5^+} f(x) = +\infty$$

## Assigned Work

p.38 #5, 6, 7, 10de, 11, 12

$$f(x) = \frac{1}{x-5}$$



$$\lim_{x \rightarrow 3} f(x) = -\frac{1}{2}$$

